

In the application of: Penich et al.
Serial No. 10/634,433 Filed: August 5, 2003
RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 2

The following listing of claims replaces all previous claims:

1. (Currently Amended) A nanolayered coated member comprising:
a substrate having a surface and a coating on the surface of the substrate;
the coating comprising a plurality of coating sets of nanolayers wherein each coating set comprising alternating nanolayers of a metal nitride and a metal aluminum nitride;
the coating including a bonding region and an outer region wherein the bonding region is closer to the surface of the substrate than the outer region; and
the bonding region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride wherein the thickness of the coating sets in the bonding region increase as one moves away from the surface of the substrate.
2. (Currently Amended) The coated member according to claim 1 wherein the metal in the nanolayers of metal nitride and the metal aluminum nitride is selected from the group comprising titanium, niobium, hafnium, vanadium, tantalum, molybdenum, zirconium, chromium and tungsten alone or in combination with each other or in combination with other metals.
3. (Original) The coated member according to claim 1 wherein the substrate is selected from the group comprising cemented carbide, cermet, ceramic, high speed steel, diamond, polycrystalline diamond, and polycrystalline cubic boron nitride.
4. (Original) The coated member according to claim 1 wherein the coating has a thickness ranging between about 1 micrometer and about 21 micrometers.
5. (Original) The coated member according to claim 1 wherein the bonding region has a thickness ranging between about 0.025 micrometers and about 0.6 micrometers.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 3

6. (Original) The coated member according to claim 1 wherein the bonding region has a thickness ranging between about 0.05 micrometers and about 0.4 micrometers.

7. (Original) The coated member according to claim 1 wherein each one of the metal nitride nanolayers and each one of the metal aluminum nitride nanolayers in the bonding region has a thickness between about 0.5 nanometers and about 5 nanometers.

8. (Original) The coated member according to claim 1 wherein each one of the metal nitride nanolayers and each one of the metal aluminum nitride nanolayers in the bonding region has a thickness between about 0.5 nanometers and about 2 nanometers.

9. (Original) The coated member according to claim 1 wherein the outer region has a thickness ranging between about 1 micrometer and about 20 micrometers.

10. (Currently Amended) The coated member according to claim 1 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride, and each one of the metal nitride nanolayers and each one of the metal aluminum nitride nanolayers in the outer region has a thickness between about 0.5 nanometers and about 20 nanometers.

11. (Currently Amended) The coated member according to claim + 10 wherein each one of the metal nitride nanolayers and each one of the metal aluminum nitride nanolayers in the outer region has a thickness between about 0.5 nanometers and about 10 nanometers.

Claim 12. Cancelled.

13. (Currently Amended) The coated member according to claim 1 wherein the metal in the metal nitride and in the metal aluminum nitride is titanium, and for

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 4

each of the coating sets in the bonding region the titanium aluminum nitride nanolayer having a thickness and the titanium nitride nanolayer having a thickness, and the thickness of the titanium aluminum nitride nanolayer being different from the thickness of the titanium nitride nanolayer.

14. (Currently Amended) The coated member according to claim 1 wherein the metal in the metal nitride and in the metal aluminum nitride is titanium, and for each of the coating sets in the bonding region the titanium aluminum nitride nanolayer having a thickness and the titanium nitride nanolayer having a thickness, and the thickness of the titanium aluminum nitride nanolayer being greater than the thickness of the titanium nitride nanolayer.

15. (Currently Amended) The coated member according to claim 14 wherein the thickness of the titanium nitride nanolayer in the bonding region remains substantially the same as one moves away from the surface of the substrate.

16. (Original) The coated member according to claim 13 wherein each nanolayer of the titanium nitride in the bonding region has a thickness ranging between about 0.5 nanometers and about 2 nanometers.

17. (Original) The coated member according to claim 13 wherein each nanolayer of the titanium aluminum nitride in the bonding region has a thickness ranging between about 0.5 nanometers and about 11 nanometers.

18. (Currently Amended) The coated member according to claim 13 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride wherein the metal is titanium, and each nanolayer of titanium nitride in the outer region has a thickness ranging between about 0.5 nanometers and about 2 nanometers.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 5

19. (Currently Amended) The coated member according to claim ~~13~~ 18 wherein each nanolayer of titanium aluminum nitride in the outer region has a thickness ranging between about 0.5 nanometers and about 11 nanometers.

20. (Original) The coated member according to claim 1 wherein for each of the coating sets in the bonding region the thickness of the metal nitride nanolayer being different from the thickness of the metal aluminum nitride nanolayer.

21. (Original) The coated member according to claim 20 wherein for each of the coating sets in the bonding region, the metal aluminum nitride nanolayer having a greater thickness than the thickness of the metal nitride nanolayer.

22. (Currently Amended) The coated member according to claim 1 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride, and for each of the coating sets in the outer region the thickness of the metal nitride nanolayer being different from the thickness of the metal aluminum nitride nanolayer.

23. (Original) The coated member according to claim 22 wherein for each of the coating sets in the outer region, the metal aluminum nitride nanolayer having a greater thickness than the thickness of the metal nitride nanolayer.

24. (Original) The coated member according to claim 22 wherein for each of the coating sets in the outer region the thickness of the metal aluminum nitride nanolayer being at least about five times as great as the thickness of the metal nitride nanolayer.

25. (Original) The coated member according to claim 1 wherein the coated member comprising one of the following: a cutting insert, an indexable cutting insert, a drill, a milling cutter, an end mill, a reamer, and a tap.

In the application of: Penich et al.
Serial No. 10/634,433 Filed: August 5, 2003
RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 6

26. (Currently Amended) The coated member according to claim 1 wherein the outer region comprising a plurality of the coating sets of metal nitride and metal aluminum nitride, and wherein the thickness of each one of the coating sets is about equal.

27. (Original) The coated member according to claim 1 further including a finishing layer applied to the outer surface of the coating.

28. (Currently Amended) The coated member according to claim 27 wherein the finishing layer comprising one or more layers, and wherein each one of the layers in the finishing layer comprising of one or more of the following: alumina, and nitrides, aluminum nitrides and aluminum carbonitrides of one or more of titanium, niobium, hafnium, vanadium, tantalum, zirconium, chromium alone or in combination with each other or in combination with other metals.

29. (Original) The coated member according to claim 27 further including a lubricous coating on the finishing coating.

30. (Currently Amended) The coated member according to claim 1 wherein ~~in~~ the metal in the metal aluminum nitride nanolayer of each coating set is titanium, and in the titanium aluminum nitride nanolayer the aluminum/titanium atomic ratio ranges between about 0.2 to about 2.5.

31. (Original) The coated member according to claim 30 wherein the aluminum/titanium atomic ratio is greater than zero and less than 1.0.

32. (Original) The coated member according to claim 31 wherein the aluminum/titanium atomic ratio is greater than 0.2 and less than 0.9.

33. (Original) The coated member according to claim 30 wherein the aluminum/titanium atomic ratio is equal to or greater than 1.0 and less than 2.5.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 7

34. (Original) The coated member according to claim 1 wherein the metal nitride nanolayer including aluminum therein, and the composition of the aluminum-containing metal nitride nanolayer being different from the composition of the metal aluminum nitride nanolayer.

35. (Original) The coated member according to claim 34 wherein the aluminum content in the aluminum-containing metal nitride nanolayer being less than the aluminum content in the metal aluminum nitride nanolayer.

36. (Currently Amended) The coated member according to claim 35 wherein the metal in the metal nitride nanolayer and the metal aluminum nitride nanolayer is titanium.

37. (Currently Amended) A nanolayered coated member comprising:
a substrate having a surface and a coating on the surface of the substrate;
the coating comprising a plurality of coating sets of nanolayers wherein each coating set comprising alternating nanolayers of a metal aluminum nitride and a metal aluminum carbonitride;

the coating including a bonding region and an outer region wherein the bonding region is closer to the surface of the substrate than the outer region; and

the bonding region comprising a plurality of the coating sets of alternating nanolayers of metal aluminum nitride and metal aluminum carbonitride, and wherein the thickness of each coating set in the bonding region increases as one moves away from the surface of the substrate.

38. (Currently Amended) The coated member according to claim 37 wherein the metal in the metal aluminum nitride and the metal aluminum carbonitride is selected from the group comprising titanium, niobium, hafnium, vanadium, tantalum,

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 8

molybdenum, zirconium, chromium and tungsten alone or in combination with each other or in combination with other metals.

39. (Original) The coated member according to claim 37 wherein the substrate is selected from the group comprising cemented carbide, cermet, ceramic, high speed steel, diamond, polycrystalline diamond, and polycrystalline cubic boron.

40. (Original) The coated member according to claim 37 wherein for each of the coating sets in the bonding region the thickness of the metal aluminum nitride nanolayer being different from the thickness of the metal aluminum carbonitride nanolayer.

41. (Currently Amended) The coated member according to claim 37 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal aluminum nitride and metal aluminum carbonitride, and for each of the coating sets in the outer region the thickness of the metal aluminum nitride nanolayer being different than the thickness of the metal aluminum carbonitride nanolayer.

42. (Currently Amended) The coated member according to claim 37 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride, and the outer region comprising a plurality of the coating sets wherein the thickness of each coating set is about equal.

43. (Original) The coated member according to claim 37 wherein the coated member comprising a cutting insert, the cutting insert having a rake surface and a flank surface, the rake surface and the flank surface intersecting to form a cutting edge.

44. (Currently Amended) The coated member according to claim 37 wherein the metal in the metal aluminum nitride and the metal aluminum carbonitride is titanium, and for each of the coating sets in the bonding region the titanium aluminum nitride nanolayer having a thickness and the titanium aluminum carbonitride nanolayer having a

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 9

thickness, and the thickness of the titanium aluminum nitride nanolayer being different from the thickness of the titanium aluminum carbonitride nanolayer.

45. (Original) The coated member according to claim 37 further including a finishing layer applied to the outer surface of the coating.

46. (Currently Amended) The coated member according to claim 45 wherein the finishing layer comprising one or more layers, and wherein each one of the layers in the finishing layer comprises one or more of the following: alumina, and nitrides, aluminum nitrides and aluminum carbonitrides of one or more of titanium, niobium, hafnium, vanadium, tantalum, zirconium, chromium alone or in combination with each other or in combination with other metals.

47. (Original) The coated member according to claim 37 further including a lubricious coating on the finishing coating.

48. (Currently Amended) The coated member according to claim 37 wherein ~~in the metal~~ in the metal aluminum nitride nanolayer and the metal aluminum carbonitride nanolayer of the coating sets is titanium, and in the titanium aluminum nitride nanolayer the aluminum/titanium atomic ratio ranges between about 0.2 to about 2.5, and in the ~~metal~~ titanium aluminum carbonitride nanolayer the aluminum/titanium atomic ratio ranges between about 0.2 and about 2.5.

49. (Currently Amended) The coated member according to claim 48 wherein the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum nitride nanolayer is greater than zero and less than 1.0, and the aluminum/titanium atomic ratio in the metal aluminum carbonitride nanolayer is greater than zero and less than 1.0.

50. (Currently Amended) The coated member according to claim 49 wherein the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum nitride nanolayer

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 10

is between 0.2 and 0.9, and the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum carbonitride nanolayer is between 0.2 and 0.9.

51. (Currently Amended) The coated member according to claim 37 wherein the metal in the metal aluminum nitride nanolayer and the metal aluminum carbonitride nanolayer of the coating sets is titanium, and in the ~~metal~~ titanium aluminum nitride nanolayer the aluminum/titanium atomic ratio ranges between greater than 1.0 and less than 2.5, and in the ~~metal~~ titanium aluminum carbonitride nanolayer the aluminum/titanium atomic ratio ranges between greater than 1.0 and less than 2.5.

52. (Currently Amended) A nanolayered coated member comprising:
a substrate having a surface and a coating on the surface of the substrate;
the coating comprising a plurality of coating sets of nanolayers wherein each set comprising alternating nanolayers of a metal nitride and a metal aluminum nitride and a metal aluminum carbonitride;

the coating including a bonding region and an outer region wherein the bonding region is closer to the surface of the substrate than the outer region; and

the bonding region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride and metal aluminum carbonitride; and wherein the thickness of each coating set increases as one moves away from the surface of the substrate.

53. (Currently Amended) The coated member according to claim 52 wherein the metal for the metal nitride, the metal aluminum nitride and the metal aluminum carbonitride is selected from the group comprising titanium, niobium, hafnium, vanadium, tantalum, molybdenum, zirconium, chromium and tungsten alone or in combination with each other or in combination with other metals.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 11

54. (Original) The coated member according to claim 52 wherein the substrate is selected from the group comprising cemented carbide, cermet, ceramic, high speed steel, diamond, polycrystalline diamond, and polycrystalline cubic boron nitride.

55. (Original) The coated member according to claim 52 wherein for each of the coating sets in the bonding region the thickness of the metal nitride nanolayer being different from the thickness of the metal aluminum nitride nanolayer, the thickness of the metal nitride nanolayer being different from the thickness of the metal aluminum carbonitride nanolayer, and the thickness of the metal aluminum nitride nanolayer being different from the thickness of the metal aluminum carbonitride nanolayer.

56. (Currently Amended) The coated member according to claim 52 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride and metal aluminum carbonitride, and for each of the coating sets in the outer region the thickness of the metal nitride nanolayer being different from the thickness of the metal aluminum nitride nanolayer, the thickness of the metal nitride nanolayer being different from the thickness of the metal aluminum carbonitride nanolayer, and the thickness of the metal aluminum nitride nanolayer being different ~~from~~ from the thickness of the metal aluminum carbonitride nanolayer.

57. (Currently Amended) The coated member according to claim 52 wherein the outer region comprising a plurality of the coating sets of alternating nanolayers of metal nitride and metal aluminum nitride and metal aluminum carbonitride, and wherein the thickness of each coating set is about equal.

58. (Original) The coated member according to claim 52 wherein the coated member comprising one of the following: a cutting insert, an indexable cutting insert, a drill, a milling cutter, an end mill, a reamer and a tap.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 12

59. (Original) The coated member according to claim 52 further including a finishing layer applied to the outer surface of the coating.

60. (Currently Amended) The coated member according to claim 59 wherein the finishing layer comprising one or more layers, and wherein each one of the layers in the finishing layer comprising of one or more of the following: alumina, and nitrides, aluminum nitrides and aluminum carbonitrides of one or more of titanium, niobium, hafnium, vanadium, tantalum, zirconium, chromium alone or in combination with each other or in combination with other metals.

61. (Original) The coated member according to claim 59 further including a lubricious coating on the finishing coating.

62. (Currently Amended) The coated member according to claim 52 wherein the metal in the metal aluminum nitride nanolayer and in the metal aluminum carbonitride nanolayer of the coating sets is titanium, and in the metal titanium aluminum nitride nanolayer the aluminum/titanium atomic ratio ranges between about 0.2 to about 2.5, and in the ~~metal~~ titanium aluminum carbonitride nanolayer the aluminum/titanium atomic ratio ranges between about 0.2 and about 2.5.

63. (Currently Amended) The coated member according to claim 62 wherein the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum nitride nanolayer is greater than zero and less than 1.0, and the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum carbonitride nanolayer is greater than zero and less than 1.0.

64. (Currently Amended) The coated member according to claim 63 wherein the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum nitride nanolayer is between 0.2 and 0.9, and the aluminum/titanium atomic ratio in the ~~metal~~ titanium aluminum carbonitride nanolayer is between 0.2 and 0.9.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 13

65. (Currently Amended) The coated member according to claim 52 wherein the metal in the metal aluminum nitride nanolayer and in the metal aluminum carbonitride nanolayer of the coating sets is titanium, and in the ~~metal~~ titanium aluminum nitride nanolayer the aluminum/titanium atomic ratio ranges between greater than 1.0 and less than 2.5, and in the ~~metal~~ titanium aluminum carbonitride nanolayer the aluminum/titanium atomic ratio ranges between greater than 1.0 and less than 2.5.

66. (Original) The coated member according to claim 52 wherein the metal nitride nanolayer including aluminum therein, and the composition of the aluminum-containing metal nitride nanolayer being different from the composition of the metal aluminum nitride nanolayer.

67. (Original) The coated member according to claim 66 wherein the aluminum content in the aluminum-containing metal nitride nanolayer is less than the aluminum content in the metal aluminum nitride nanolayer.

68. (Currently Amended) The coated member according to claim 67 wherein the metal in the metal nitride nanolayer and the metal in the metal aluminum nitride nanolayer and the metal in the metal aluminum carbonitride nanolayer is titanium.

Claims 69 – 123. Cancelled.

124. (Original) A nanolayered coated member comprising:
a substrate having a surface and a coating on the surface of the substrate; and
the coating comprising a plurality of coating sets of nanolayers wherein each coating set comprising alternating nanolayers of titanium aluminum nitride and titanium aluminum carbonitride.

In the application of: Penich et al.

Serial No. 10/634,433 Filed: August 5, 2003

RESPONSE TO OFFICE ACTION OF JUNE 17, 2004

Page 14

125. (Original) The nanolayered coated member according to claim 124 wherein the coating including a bonding region, the bonding region being adjacent to the substrate surface.

126. (Original) The nanolayered coated member according to claim 125 wherein the bonding region comprising a plurality of the coating sets wherein the thickness of each coating set increases as one moves away from the surface of the substrate.

127. (Original) The nanolayered coated member according to claim 125 wherein the coating including an outer region, the outer region being adjacent to the bonding region.

128. (Original) The nanolayered coated member according to claim 125 wherein the outer region comprising a plurality of the coating sets, and wherein the thickness of each one of the coating set being about equal.